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Technology is applied, organized knowledge which causes the miracles we daily take for granted. The rapid development and application of technology is illustrated by accelerated rate of change. The educational system has been based on a concept of stability, and the present generation is the first which must educate youth for the new dimension of time and change. There is less and less opportunity for the uninformed and untrained worker. More and more specialized education must be provided. The shortage of specialized technicians and supportive workers and the evident supply of educable persons represents an unprecedented challenge to junior and community colleges. Individualized programs, often including remedial studies, relating to each student's field of interest must be provided. Graduates of such programs may then achieve a level in the work force in 3 to 5 years that would normally take 12 to 15 years by past standards. New legislation dealing with occupational education provides funds for developing new programs, improving program relevancy, long-range planning, meeting needs of special-needs groups, exemplary programs, residential schools, work-experience programs, development and dissemination of curriculum materials, studies of manpower needs, and vocational educator professional development. (DM)

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

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THE DYNAMICS OF TECHNOLOGY AND SOCIETY: NO COMPROMISE WITH IGNORANCE

An address by Grant Venn, Associate Commissioner for Adult, Vocational and Library Programs, U.S. Office of Education, presented at the American Association of Junior Colleges at the Michigan State University, E. Lansing, Michigan, February 21, 1969.

THE DYNAMICS OF TECHNOLOGY AND SOCIETY: NO COMPROMISE WITH IGNORANCE

By Grant Venn, Associate Commissioner
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Societies reflect, in large measure, the degree of application of technology. In the United States, we live in a society markedly different from any previous one--largely because of the extent of the application of advanced technology.

Technology is applied, organized knowledge--causing the miracles we daily take for granted. These have come about because we have learned to harness energy instead of human beings and beasts of burden. We have learned the systematic control of elements and forces available to us, instead of making use of uncontrolled, naturally occurring materials for our needs.

Sophisticated, technological knowledge and practice affect our lives by causing machines to do our work, by managing equipment and elements to control our environment, by using complex computers to assist in solving our scientific problems. Controlled combinations of chemical elements produce dramatic metallurgical and plastic materials which make modern machine instruction possible and produce the modern miracle drugs, fertilizers and pesticides.

Applied biological science has led to the fantastic modern agricultural production of food and fiber and the giant strides in medical practice.

Organized technological knowledge in the social sciences is developing the potential for serving the well-being of our population attitudes, desires, organized learning and many complex social services.

The rapidity, the progression of development and increasing application of technology in the United States is illustrated by the accelerating rate of change in several common activities.

THE DIMENSION OF CHANGE

As I have said in other places, this nation--and Western civilization in general--have changed so much and so rapidly in the last decade or two that the result cannot properly be looked at as a change of degree--but as an entirely new factor: a change of kind. The application of science and technology to the agricultural, industrial and commercial institutions of our society have been so great as to create a revolution in the social, economic and educational operations of the country.

The current technological explosion may well be illustrated by the scientific probability that nuclear energy through fissionable materials now created by man will provide enough energy to do all the work man needs to have done. Genetics, population study and growth, the lunar space program, and the whole field of meteorology and weather control have great portent for the future as they act to change man's concept of work.

If this concept of change were plotted on a graph, the lower co-ordinate would represent time--with the lower left corner being the beginning of man's history and the lower right corner being the present. The vertical coordinate would be change--represented by a number of factors: the speed with which man moves over the face of the earth, the amount of knowledge he has accumulated, the ammount of material goods available, the increased availability of energy, and actual change in the nature of work.

We could then see the dimension of change in terms of man's role as a contributor to society. The curve would run almost flat along the whole distance of the horizontal axis of this immense chart for about two miles to a point in time around 1940 or 1945. It would then swerve upward at an exponential rate for nearly the entire vertical distance to the present, indicating that the factor of change itself has become an entirely different matter.

Historically, man has based his educational system and preparation for a role in society on a concept of stability. Changes which occurred took place over a period of generations. Our present adult population was educated with this concept in mind and grew up under these kinds of conditions. But the present generation of young people find themselves engulfed in extreme change. We are in effect the first generation who must help educate young people to this new dimension of time and change.

THE RISKS OF IGNORANCE

The more complex a society becomes because of applied technology, the more dangerous it can become for its members. Perhaps the greatest danger of all, however, is technological ignorance on the part of the Nation's work force.

Highly developed technology permits no compromise with ignorance.

The preparation of workers in a technological society must be of the highest quality and must meet the needs of safety as well as efficiency. More and more, our lives depend on the performance of informed, skilled technicians and other occupational specialists. In hospitals, our lives are dependent upon scientific accuracy and upon a competent understanding of techniques by the technicians and nurses. The use of aircraft and automobiles places our lives in the hands of the people who designed and built the machines and in the hands of those who maintain, repair and operate them. The water and food we use must be guarded from chemical or biological contamination by highly informed scientists, technicians and skilled workers.

The general well being and attitudes of our population are becoming increasingly dependent upon the teachers, social scientists and even upon the specialized knowledge of merchandising and distribution--which touch the lives of us all. There is less and less opportunity for the uninformed and untrained worker in these fields in today's technological society.

A MANDATE FOR TRAINING

Increased application of technology in a society thus automatically sets a mandate for an educational requirement. More and more specialized education must be provided to larger numbers of people so they may understand the technical principles of their work and the significance of special skills and techniques which they must learn.

Many of the special skills and competencies which must be learned in a technically sophisticated society require organized study of basic sciences plus actual work in a learning situation. Examples are the clinical practices for nurses and the intership for doctors. Basically, these are cooperative work experience arrangements. Since mistakes caused by ignorance or carelessness can be so serious in these situations, much of the specialized education must be acquired after the individual has become an adult--with the mature capabilities for judgment and attitudes of stability, consistency and responsibility we can reasonably expect from an adult.

Much of the specialized education for nonprofessional, but highly specialized workers must also be provided after high school. This education must be equivalent to a college learning experience and more and more is being so described and recognized as nonbaccalaureate specialized occupational collegiate education.

THE CAPACITY FOR EDUCATION

The question might reasonably be asked, "Has this Nation's population the required mental or intellectual capacity to maintain or increase our technological society's development?" We already have reached the point in time when persons who want to work but who have no saleable or specialized skills or knowledge have no assurance of being able to find work and often cannot. Is our population sufficently educable to meet the challenge of the complications of today's world of work?

There is overwhelming evidence that our population is capable of meeting the challenge. One indication of the general ability of our population is evident from the tests given to all who enter the United States Armed Forces. The Army general classification test has been given to hundreds of thousands. Those tested show wide variations in the amount of their formal education, but it is significant that more than half those who took the test scored higher than many college graduates and even higher than some who held doctoral degrees.

More than two-thirds of the high school graduates had scores that were higher than many college graduates.

In spite of this indicated high ability shown by the Army general classification test scores, fewer than 4 out of 10 who graduate from or leave high school enter college and only slightly more than 2 out of 10 are graduated with a baccalaureate or higher degree.

As a matter of fact, the present stage of sophisticated technological development confronts society with a serious shortage of the kind of worker requiring a nonbaccalaureate collegiate education. These are the supportive, occupational specialists such as technicians, associate degree nurses and similar specialized health workers, accountants, social workers, teaching assistants and agricultural equipment or production specialists.

THE CHALLENGE TO JUNIOR COLLEGES

The increasingly critical shortage of specialized technical and supportive workers on the one hand and the evident supply of educable persons on the other--those who have left high school or who have been graduated from high school but who are not pursuing organized programs of education to prepare them for careers in a technological society--represents an unprecedented challenge to junior and community colleges.

For every student who enters collegiate programs there are perhaps three or four who either apply for admittance and are rejected or who do not apply at all because they do not want a four-year baccalaureate program or who believe they cannot accomplish one. Nearly half the students who enter college programs directed toward a baccalaureate degree do not complete the program or receive the degree.

Our traditional "Horatio Alger" concept of self-determination and our singular emphasis on liberal or professional education requiring a baccalaureate degree or more has been a major factor in causing us

to neglect to provide collegiate educational programs for the non-baccalaureate technician--the specialized occupational person unique to this society.

The requirement for organized scientific knowledge and the mathematics which supports it for entry into many of the post-high school occupational programs is comparable to that required for entering baccalaureate programs. Many students, for various reasons, do not prepare themselves while in high school by studying more than a minimum of science and mathematics and many do not develop a facility with reading, writing and speaking which would insure a reasonable probability of success in these specialized occupational programs.

Weakness in these subjects is a major cause of the high rate of failure (often over 50 percent) of students who undertake two year post-high school technician education programs. However, it has been observed that institutions which can select students with good qualifications in language, science and mathematics have relatively low rates of student failure.

ONE APPROACH TO THE PROBLEM

The problem of meeting the challenge of a large population of able, but not fully qualified, students for educational programs to meet technical worker requirements essentially requires that educational services be provided in an organized manner for able, willing and well-motivated students. This must start at the point in educational prepa-

ration which each individual has attained and provide the missing reading, science or mathematics which are the prerequisites for successful mastery of the occupational program to which the student aspires.

These programs must be "individual," in the sense that they provide a special program for each individual in order to repair his academic deficiences. They must be administered in such a way as to relate to the special field of interest in which the particular student expects to prepare himself and make a career.

While the program for each individual must be tailored to his needs and must include from the beginning some direct involvement (usually in laboratory work) in his special field of interest, groups of students with similar gaps in their academic preparation can be found and can be formed into classes of students large enough to justify special staff, facilities and teaching programs to serve their needs.

EXTENDED POST-SECONDARY PROGRAMS

Junior college and technical institute administrators who have provided these special programs (some with over 20 years experience in providing such programs) agree that for many students, especially those who require the equivalent of one year of mathematics or one year of science with laboratory experience or both, should devote as much as two semesters to their remedial studies in those subjects. At the same time, these students can become involved in studies in their

particular field of interest. This means that the total program of remedial studies plus the special two-year occupational curriculum will require more than two years; since the program requires two years for students who are fully qualified when they begin.

Administrators of these programs also state that when students have had the benefit of programs to remove their academic deficiences as a part of their occupational study programs, the morale of the students and instructor both are improved; the number of students who drop out because of academic failure is greatly reduced; the total cost of educating these specialized occupational personnel is reduced because of better use of facilities, teachers and fewer failures; and better qualified graduates are produced, making them more sought after by employers.

In addition, these programs permit able young people to complete an educational program which they could not have entered except for the remedial or upgrading preparatory study provided. Upon graduation, they are equipped to enter upon employment at a level to which they could not have aspired without this special preparation.

EDUCATORS OF PROFOUND WORTH

The value to the individual of such an opportunity usually allows him, in 3 to 5 years, to arrive at a degree of productivity and responsibility that normally would take him 12 to 15 years by past standards if he entered and picked up his education on the job by diligent work and study.

This means a net gain of some 10 years of high productivity, benefiting both the individual and his employer as a direct result of the student having an opportunity to overcome his academic deficiencies and successfully prepare himself for higher-level employment.

Such benefits are worth going after. The need for this kind of training is increasing geometrically and the technical trainer in today's society has become a key man--an educator of profound worth.

We find ourselves today in a situation where the necessity of finding a role for each person in society rests to a great extent upon his work role. Occupational education then becomes a basic necessity for the general welfare because any man who cannot work becomes a drag on society--economically, politically and psychologically. So we arrive at the premise that occupational education now must become a fundamental part of the total educational system for every individual.

No one in education is better qualified--or has a better opportunity--to provide for this need than the technician educator. And he is in far the best position to know what is needed in the future in this field--in quantity, in variety and in quality. Certainly he knows that many more technicians are required than are being produced every year just to meet the needs of presently established technologies.

THE NEW LEGISLATION

In October of 1968 in Washington, D.C., an event occurred which will surely have important, far-reaching effects on the education of

technicians for years to come--the dual ceremony at the White House when President Johnson signed into law the 59th and 60th education acts approved by Congress during the current administration.

The first important piece of education legislation which President Johnson signed after taking office in 1963 was the Vocational Education Act of that year. The last piece of education legislation he signed as President was the Vocational Education Amendments of 1968, immediately following his signing of the Higher Education Amendments of 1968. Between them, these latest acts provide for programs, curriculum materials and construction assistance which will benefit in a measure yet unforseen the vocational and technical programs of the Nation.

For example, the vocational education amendments provide special emphasis and financial support for programs to help qualify able students for entrance into the specialized post-secondary occupational training which are described here.

Taken as a whole, the new Vocational Act--Public Law 90-576--is the most sweeping and significant legislation dealing with occupational education in history.

The new Act will not only strengthen existing programs, but will develop new ones designed especially to equip inner city youths, disadvantaged adults and handicapped persons with both employability and job skills. It gives public schools for the first time a major opportunity to reach those most in need of a new educational approach.

Vocational funds should now become available for use in programs to serve ALL youngsters. A student need not decide to become a vocational enrollee to gain benefits from it. The Act permits courses for only one semester--or orientation for occupations at the elementary and junior high school levels. It also focuses on youngsters who have special needs in the areas of high student dropout and high youth unemployment, providing earmarked funds for these areas.

DEVELOPING NEW PROGRAMS

Special funds also are provided for the development of new programs in areas that presently do not have specific vocational education. These would include emerging occupations in the new human services field and in the technical fields. In addition, there are specific provisions for vocational education for handicapped children. The Act also provides expanded support for a realistic partnership between business, industry and education--where students may be in school part-time and at work part-time as a normal phase of their education process.

At present, it is estimated that there should be two technicians to every engineer or professional physical scientist; there should be 6 to 10 technicians for every medical doctor or professional researcher in the health fields and four to five for each professional biological scientist.

THE 4th "R"

The job of our Nation's schools is particularly critical in view of these new and emerging occupations and the resultant demands to be

faced by the labor force. Educational programs need to be made more relevant. This concept--relevancy--could be recognized as the 4th "R" in modern education. Emphasis should be on how students perform, not just on their mastery of subject matter. Achieving this objective may require a new purpose for the public schools. They must become "including in" rather than "selecting out" institutions. Program development must become more closely attuned to individual interests, aptitudes, ambitions, needs and subsequent occupational and educational requirements for every boy and girl. We can no longer teach some and not others.

The Vocational Education Amendments of 1968, I believe, provide a way to bring about the required changes. They are designed to help the "hard-to-reach" and "hard-to-teach." The new Act places resources and program flexibility at the discretion of State and local school agencies and is focused on the major deficiences of the past. It is a major breakthrough, concentrating established forces of education in the United States on the problems of the ghetto, the disadvantaged student, the handicapped trainee and the school dropout as well as on the potential technician. In full operation this program could affect more than 25 million people a year.

How can the Act bring about these needed changes?

For one thing, it authorizes more than double the current appropriations for the regular State grant programs, making possible great expansion of vocational education programs and a good start on many

new programs. These grants are generally on a 50-50 matching basis. State plan requirements are specified for programs designed to insure that training for career vocations is available to all who need it or desire it. Standards for preparing and approving State plans are strengthened and States must prepare annual and long-range plans and evaluations.

THE NEW STATE PLAN

Because the new Act calls for an annual State plan that not only covers the current year but also the succeeding four years each time it is submitted, it is going to help provide for long-range planning development and evaluation. Each plan must be presented in a public hearing for people throughout the State, as well as to members of the State Advisory Committee. Thus, more ideas and more talents will be brought to bear on State plans.

The Act also authorizes funds to be made available to the State Advisory Committee and to the National Advisory Committee to hire staff, to contract studies and other work necessary to evaluate and review the plans. With these new ingredients the State plan is bound to become a more creative instrument for improving vocational education.

Another important point: the new Act authorizes $40 million in additional funds for fiscal years 1969 and 1970 for special programs for the disadvantaged. No State matching is required for these programs which are designed for persons who have academic, socio-economic or other handicaps that prevent them from succeeding in the regular program.

In addition, beginning with fiscal year 1970, emphasis on vocational education programs for the disadvantaged, the handicapped, dropouts and youthful unemployed is assured by earmarking specific percentages of State allotments for these purposes.

EXEMPLARY PROJECTS

One of the new Acts most important provisions, in my opinion, authorizes some $222 million in the next four years for pilot programs and projects. Half of this sum may be used by the Commissioner to pay all or part of the costs of projects that will create what the law calls "a bridge between school and earning a living for young people, who are still in school, who have left school either by graduation or dropping out, or who are in post-secondary programs of vocational preparation," and for promoting cooperation between public education and manpower agencies. The remaining 50 percent may be used by State boards for making grants to local educational agencies to pay all or part of the costs of developing and operating exemplary occupational education programs.

These exemplary programs call for imaginative new approaches to vocational education. They should include those designed to familiarize elementary and secondary school students with the broad range of occupations for which special skills are required and the requisites for careers in such occupations; those providing students with educational experiences through work during the school year or in the summer; and

those calling for intensive occupational guidance and counseling during the last years of school and for initial job placement. I believe that secondary and post-secondary schools should be given the responsibility of obtaining entry jobs for students not planning for professional careers, just as in the past they have been responsible for getting academic graduates into baccalaureate programs.

RESIDENTIAL SCHOOLS

Also, the 1968 Act makes provisions for constructing and operating residential vocational schools for youths 15 to 21 years of age. It authorizes funds to be used by the Commissioner to make grants directly to State boards, colleges and universities, and public education agencies for this purpose. In addition, it authorizes the States to plan, construct and operate residential vocational education facilities--with the Federal share of the cost set at a maximum of 90 percent. It also authorizes such sums "as may be necessary" for making annual grants to reduce the cost of borrowing for the building of residential schools and dormitories.

By taking disadvantaged youths out of their unfavorable environments, residential schools could effectively train them in both employability and jobs skills in an atmosphere conducive to learning.

The new legislation also authorizes appropriations for cooperative vocational education programs.

Cooperative work-study programs offer many advantages in preparing young people for employment. Through such programs, a meaningful work experience is combined with formal education enabling students to acquire knowledge, skills and appropriate attitudes. They remove the artificial barriers which separate work and education and, by involving educators with employers, create interaction whereby the needs and problems of both are made known. This makes it possible for occupational curricula to be revised to reflect current needs in various occupations.

The Act provides for financial assistance for personnel to coordinate such programs and to provide instruction related to the work experience; to reimburse employers when necessary for added costs incurred in providing on-the-job training and supervision.

MORE WORK EXPERIENCE PROGRAMS

In addition to cooperative work experience programs, the Act authorizes funds for work-study programs. These will enable schools to give needy youths taking vocational education and unemployed youthful dropouts enrolling in vocational programs part-time employment in public institutions or agencies. Although these jobs may not necessarily be relevant to their classroom work, they will make it financially possible for youths between the ages of 15 to 21 to remain in school and to learn good work habits.

The new Act authorizes funds for consumer and homemaking education. At least one-third of the Federal funds shall be used for programs in economically depressed areas or those with high rates of unemployment which will assist consumers and improve home environments and the quality of family life. For this particular purpose the Federal share will be 90 percent. For the regular homemaking education programs the Federal share will be the standard 50 percent.

Under the new legislation, 10 percent of funds appropriated for regular programs are to be used for research and training--half for grants by the Commissioner and half for grants by State boards in support of research and training in vocational education, experimental and demonstration programs, and to meet special needs of new careers and occupations.

SPECIAL FEATURES OF THE ACT

The Act also includes a program of grants and contracts by the Commissioner with colleges and universities, State boards and other organizations, to promote the development and dissemination of vocational education curriculum materials.

In addition, special studies will be made by the Department of Labor to determine national, regional, State and local projections of manpower needs.

And, finally, the legislation authorizes appropriations to enable the Commissioner to give leadership development stipends to vocational education personnel to attend vocational education development programs

at colleges and universities and State programs of inservice training and retraining of experienced personnel, including exchange of teachers with skilled technicians in industry; special institutes, and to familiarize teachers with new curricular materials.

This gives us, for the first time, authorization for money to train vocational teachers and I think we are going to be able to be more creative in this field than anywhere else in education because we're not tied down to certification requirements and other limitations to obtain the kinds of personnel that are needed.

THE COMMITMENT TO EDUCATION

The United States is an affluent, strong and influential nation. Much of its success and its position of world leadership can be attributed to an impressive record of technological and economic advances, and to a strong historical commitment to education for all. These advances, however, have been accompanied by serious economic and social problems, such as urban and rural poverty, school dropouts, racial inequalities, educationally disadvantaged populations, manpower shortages and unemployed and underemployed people. Solutions to these problems depend largely upon the Nation's ability to maintain a highly educated, skilled and flexible work force.

Many of our most vexing dilemmas have resulted from changes in the nature of work. Old jobs are disappearing or being altered; new ones are emerging. Relocation of industry and shifts in market demands

have further complicated the labor market. In addition, jobs for which physical strength and untrained minds were sufficient have drastically declined, while jobs requiring specific skills and advanced learning have greatly increased.

THE NEW MANDATE: P.L. 90-576

These are the reasons the Administration proposed new vocational education legislation to the 90th Congress and the reasons we have this new mandate from Congress.

The long-range effect of Public Law 90-576 and other education legislation passed by the 90th Congress will have to await the judgment of history. But I feel confident I can forecast some important effects within a year from today. With enlightened leadership in the community and junior college field and among the four-year institutions offering vocational-technical courses, there is every reason for us to expect important strides forward in post-secondary technical education in the United States.

These, then, are the dynamics of technology and society, as I see them, from the standpoint of education for the world of work. Our enemy is clear: it is ignorance. And modern technology will brook no compromise with ignorance.

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